

Research and Development Overview

North Carolina
DEPARTMENT OF TRANSPORTATION

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Research and Development Manager
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RESEARCH & DEVELOPMENT

Research and Development Functions

Develop an Annual Research Program

Provide implementation and technology transfer support of local and national research for business units

Rapid turnaround, 80 hour Technical Assistance Projects



Research and Development Functions (2)

Distribute research results locally and nationally

Research Library services

Engage NCDOT personnel in national research programs: TRB, NCHRP, Pooled Fund, SHRP, LTPP etc

Provide Research Management Services –
Administer contracts for Branches/Divisions/Units
working with Universities



Annual Research Program

Match NCDOT research needs with expertise at universities and transportation research centers

Initiate ~20 - 25 new projects per year

Manage ~80 active research projects

Nearly all NCDOT activities are eligible



Annual Research Program Goals

Improve NCDOT Planning, Engineering and Business Practices

Support NCDOT Operations and Maintenance Activities

Conduct research that can be implemented

Develop relationships with researchers so they understand the needs and operations of NCDOT to maximize research benefits



Annual Program FAQ

Who typically submits Research Needs to the R&D Unit?

Anyone at NCDOT, with manager approval

University researchers in coordination with DOT business units

Do the Universities decide what research will be done?

No. NCDOT selects all projects

Starts with topical Subcommittees

Research Executive Committee approves final program

How long does it take for an Idea to become a project?

Typically 1 year from close of solicitation period



Annual Program FAQ

How long do
Research Projects
Last?

Variable

2 years is
typical, can be
as short as 6
months or as
long as 3 years

What types of
Projects are
common?

Laboratory / Field
Testing and analysis

Policy / Practice /
Design Analysis

Best Practice
Synthesis

Etc, etc.

How are Projects
managed?

Research Unit
handles fiscal and
contract portion

Steering Committee
reviews technical
content

Committee Chair is
often the idea
submitter



Program Structure

Research and Development Unit Oversees Program

Solicits Ideas

Research Engineers Manage Projects

Coordinates all Activities

Research Subcommittees Review and Recommend Proposals for Funding

Environmental and Water Resources

Geotechnical, Structural and Construction

Pavement and Maintenance

Policy, Program Development, Planning and Transit

Traffic, Mobility and Safety

Research Executive Committee Approves Work Program

Senior Management

Executives



How is Research Funded?

State Planning and Research (SPR) Part 2

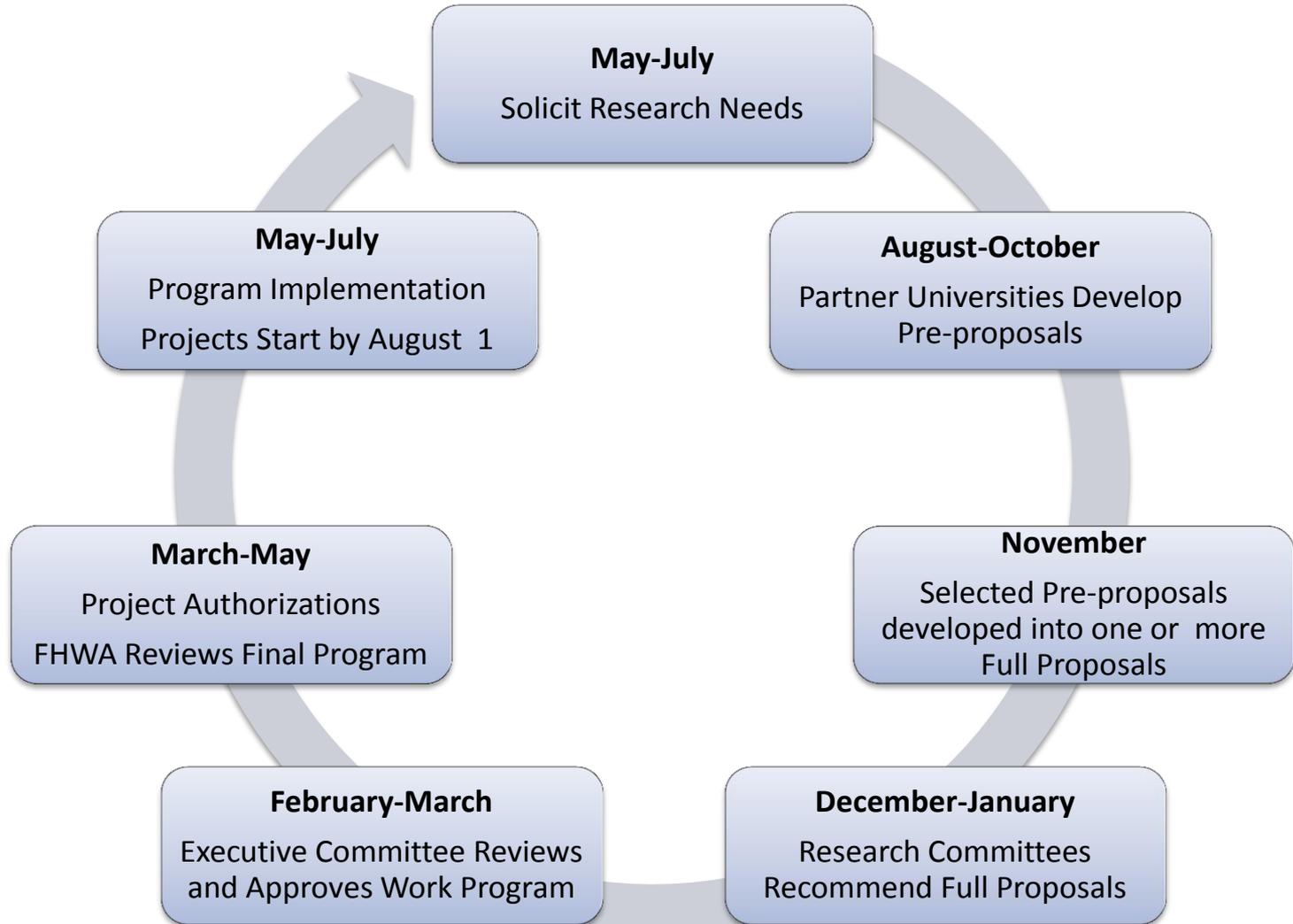
- Annual Work Plan (80% / 20% Match)
- NCHRP Studies (100%)
- AASHTO Pooled Fund Program (100%)

Federal Discretionary Funds Typically Grants - (100 % Fed)

State or Other Federal Funds



Research Program Annual Timeline



Past and Present University Participants

Appalachian State*

Duke

East Carolina*

Elizabeth City State

NC A&T*

NC Central*

NC State*

UNC-Asheville*

UNC-Chapel Hill*

* Master Agreements

UNC-Charlotte*

UNC-Greensboro

UNC-Wilmington

Indiana State*

Michigan State*

Virginia Tech*

Central Florida*

Illinois

Auburn

Current Research



National Involvement



Long-Term Pavement
Performance Study



Pooled Fund –
NCDOT Manager



National
Representative



Research Advisory
Committee
Representative



Coordinator for
NCHRP Pooled Funds

Research Library Services



Completely revamped and reorganized library

On-staff Librarian provides Research Services -
Has access to national databases

Many engineering and transportation related
books, journals, specs and other documents

Historical information to the 1920s

Board of Transportation Minutes



One research project can have a large impact in several areas: Material Performance, Safety, Environmental Management, Congestion Management, Project selection, Policy Goals...



Recent Successes



Stormwater and Roadside

NPDES Permit Support

Stormwater Best Management Practices Toolbox and training

Vegetative treatment of runoff

Revised EPA guidelines

Improved sediment and erosion control

Herbicide and wildflower optimization



Environmental Research Projects

Multi-sensor Precipitation Alert and Visualization Tool

The State Climatic Office (SCO) of North Carolina developed a Multi-sensor Precipitation Estimate (MPE) website for the NCDOT - Highway Stormwater Program.

Enables engineers to closely monitor estimated precipitation amounts at NCDOT construction and operation related sites

User can identify their own lat/long monitoring sites and receive an email and text message alert when precipitation has exceeded a particular threshold within 24 hours.

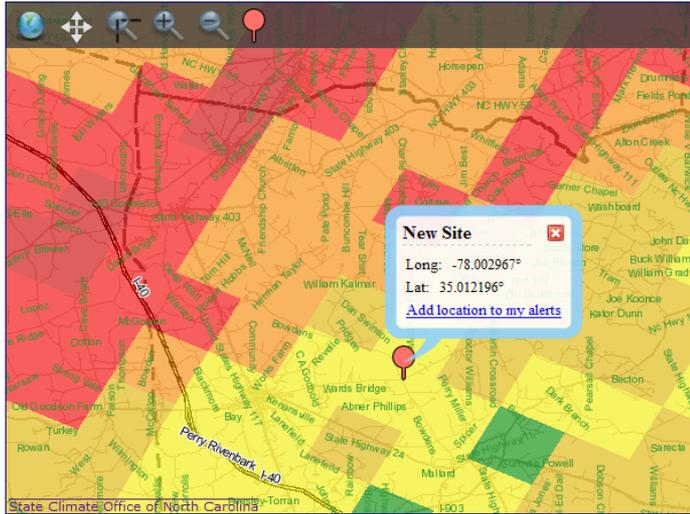
Allows rainfall data to be overlaid with other data layers such as county lines, cities, NCDOT primary and secondary roads, and water features.

The rainfall monitoring and alert tool has been estimated to save in excess of 113,000 man-hours per year.

<http://www.nc-climate.ncsu.edu/dot>



- Select Layers:
- MPE:
- Precip estimate
 - My Project Sites
- Geographic:
- County lines
 - Cities
 - Rivers and Streams
 - Shaded relief
- Transportation:
- Interstates
 - Primary Roads
 - Secondary Roads
- Special Layers:
- Land Mask



Time Period:
Last 72 hours

Map depicts previous 72 hours ending at 7am on Feb 20, 2008, EST using the 6-hour files.

- Legend:
- <= 0.2 in.
 - 0.2 - 0.4 in.
 - 0.4 - 0.6 in.
 - 0.6 - 0.8 in.
 - 0.8 - 1 in.
 - 1 - 1.2 in.
 - 1.2 - 1.4 in.
 - 1.4 - 1.6 in.
 - 1.6 - 1.8 in.
 - 1.8 - 2 in.
 - 2 - 2.2 in.
 - 2.2 - 2.4 in.
 - 2.4 - 2.6 in.
 - > 2.6 in.
- Interstate Hwy
 - Primary Road
 - Secondary Road
 - County Lines

Make PDF

Climate Office of NC: DDT precipitation - Microsoft Internet Explorer

Multi-Sensor Precipitation Estimates (MPE)

Welcome, Ken Pace. Use the links above or below to navigate this website.

The precipitation estimates provided herein are derived from the NWS WSR-88D Doppler Radar. Radar precipitation estimates can be grossly inaccurate, so radar-based precipitation values are calibrated with the routinely available hourly surface gauges. The combined product provides the spatial resolution of radar with the increased accuracy of surface gauge networks. These gauge-calibrated radar estimates are known as Multi-sensor Precipitation Estimates, or MPE.

There are still errors in MPE. A study by the State Climate Office of North Carolina suggests that MPE compares well with an independent daily precipitation gauge network over the Carolinas. The annual regional average root mean square error (RMSE) is 0.023 inches over a 24-hour period. Details of this study are available [online](#).

The MPE grids used in this tool are routinely produced by the National Weather Service and National Centers for Environmental Prediction.

MAP

This simple mapping application enables you to visually see accumulated MPE estimates over time. When zoomed in, roads, water features, and town names can be overlaid for reference. Additionally, your project sites can be noted on the map for additional reference. The past 6, 12, 24, 48, and 72 hours are available to view spatially 1-week, 30- and 90-day options are also available.

MY PROJECTS

Project Name	Lat	Long	Alert	Alert Threshold	Precipitation (inches)	More Info			
	Lat	Long			6-Hours	12-H	24-H	48-H	72-H
✓✓ 480000	35.28	-78.01	near	0.15	0	0	0	0	0
✓✓ 480001	35.28	-78.01	near	0.15	0	0	0	0	0
✓✓ 480002	35.28	-78.01	near	0.15	0	0	0	0	0
✓✓ 480003	35.28	-78.01	near	0.15	0	0	0	0	0
✓✓ 480004	35.28	-78.01	near	0.15	0	0	0	0	0
✓✓ 480005	35.28	-78.01	near	0.15	0	0	0	0	0

MY PROJECTS

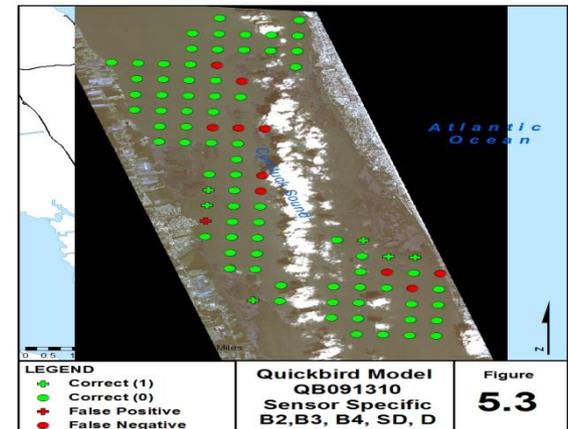
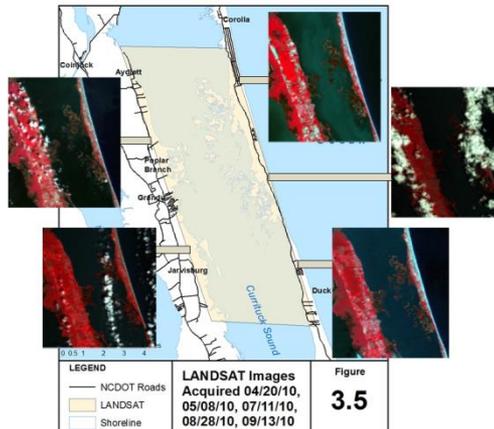
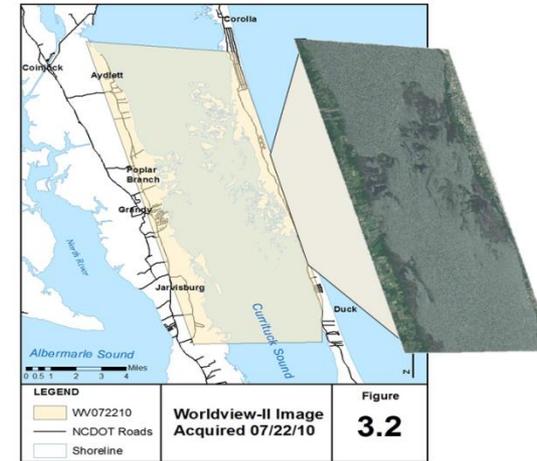
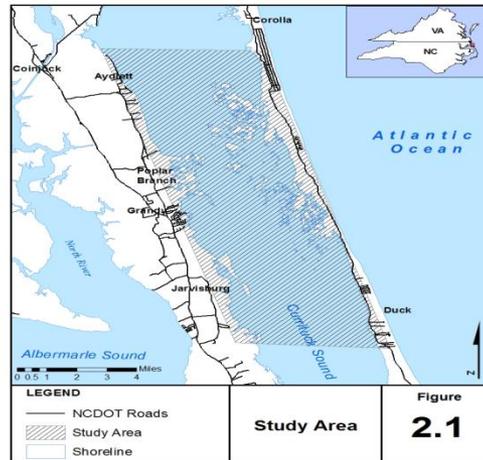
This page shows a list of all projects that you are subscribed to receive precipitation alerts from. Each project has a list of associated sites. Accumulated MPE values are listed for all sites in text format. You can also view all projects.

Environmental Research Project 2010-14

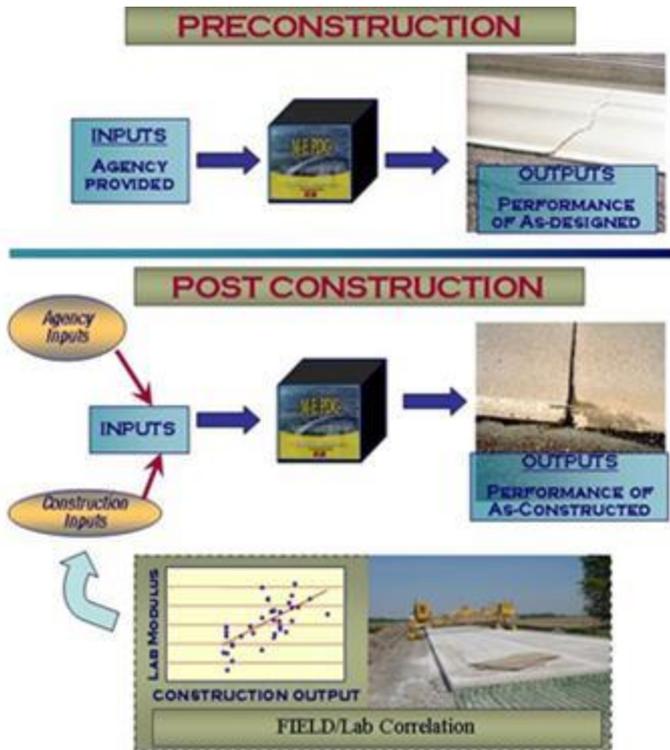
NCDOT Required to Address Submerged Aquatic Vegetation (SAV)

Currituck Sound in the Albemarle-Pamlico Estuary System: 13x5 Mile Area

Reduce Labor-Intensive SAV Mapping: Use High Resolution Satellite Imaging



Pavement Research - Design



Local Calibration of the MEPDG for Flexible Pavement Design

Development of Traffic Data Input Resources for the MEPDG Process

MEPDG Inputs for Warm Mix Asphalts

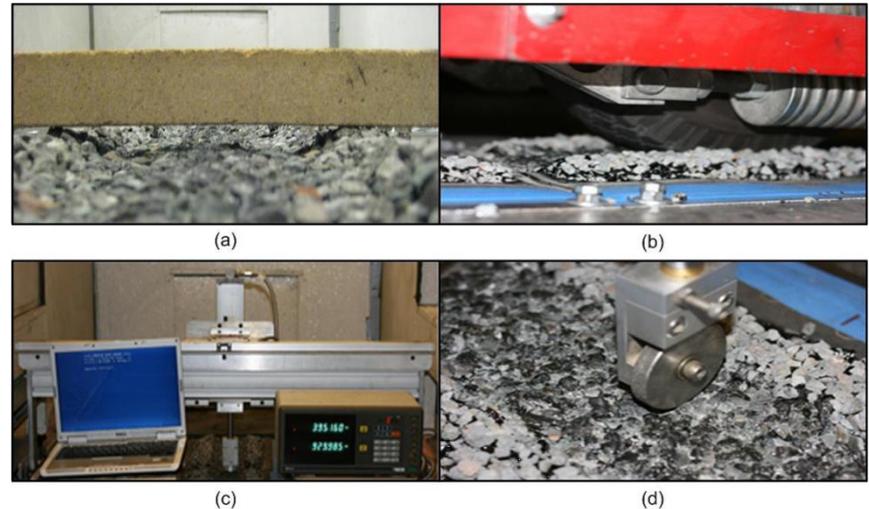
Improved Climatic Data for the MEPDG

Pavement Research – Chip Seals

Optimizing Gradations for
Surface Treatments

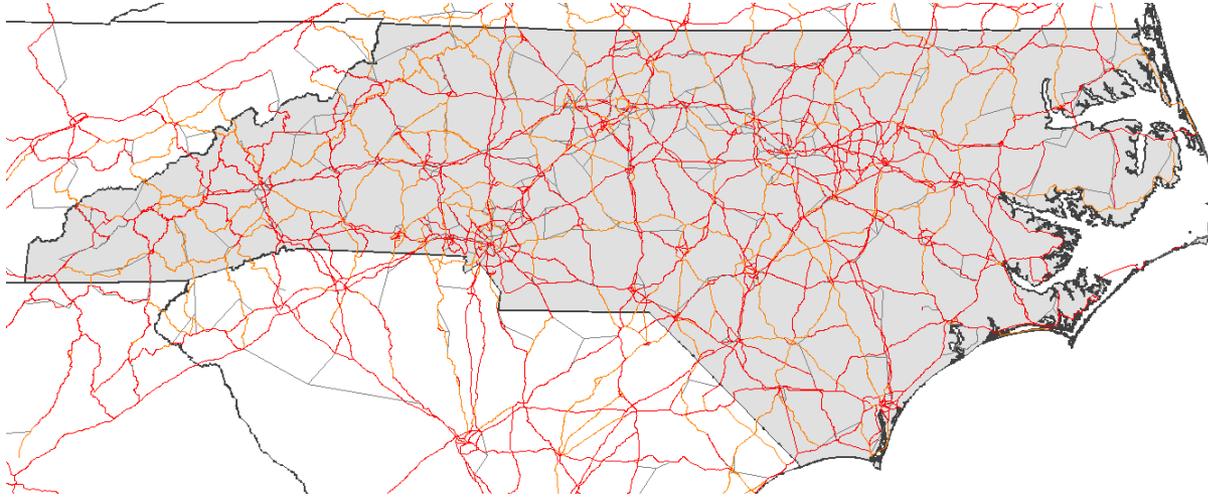
Quantifying the Benefits of
Improved Rolling of Chip Seals

Performance-Based Analysis of
Polymer-Modified Emulsions in
Bituminous Surface Treatments



Seal Improvement Research

North Carolina Statewide Transportation Model



Agile approach: Built to incorporate future analysis “add-ons”

Multi-Layered: Works at national, statewide, and urban levels

Statewide & Regional Tier Roadways (~15,000 CL Miles)

Simulate Truck Trips

2009 Base year – Future Years (2020 & 2040)



Research Project No. 2012-09

Crack Free Mass Concrete Footings on Bridges in Coastal Environments

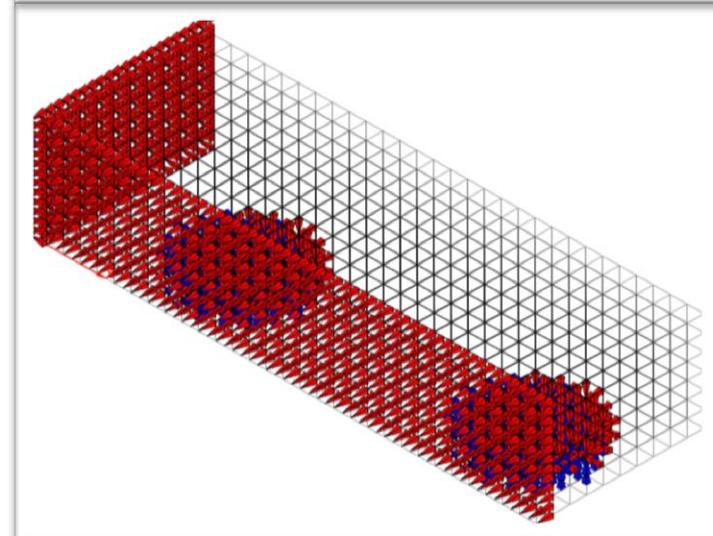
Proposed some specific additions and revisions to the current NCDOT mass concrete specifications:

Revision to material specifications allowing the use of granulated slag replacement of cement

Revision to construction methods/curing procedures

Requirement for immediate remedial actions from the contractor if the temperature differentials are exceeded

Additional requirements for Special Case "Massive" Mass Concrete (Minimum Dimension = 14 ft.):



Research Project No. 2007-11

Subgrade Stabilization Alternatives to Lime and Cement

Developed a computer application using a model to make predictions of subgrade temperatures and cured strength.

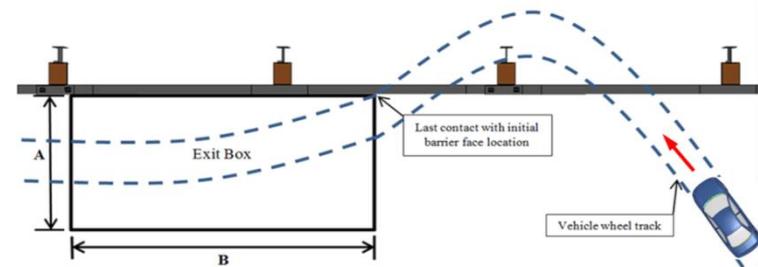
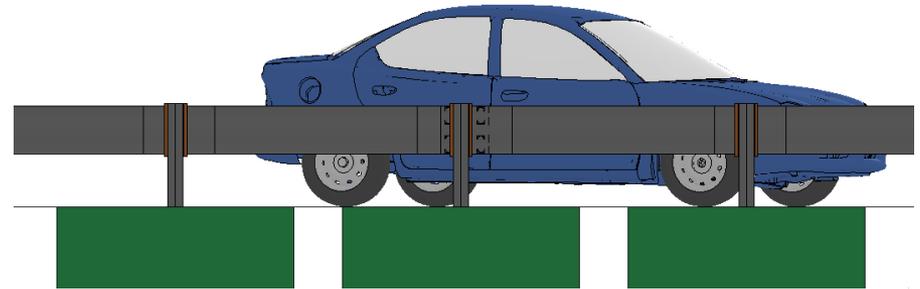
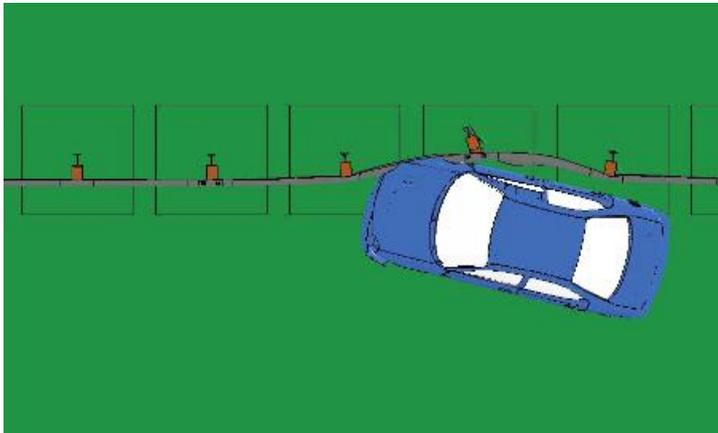
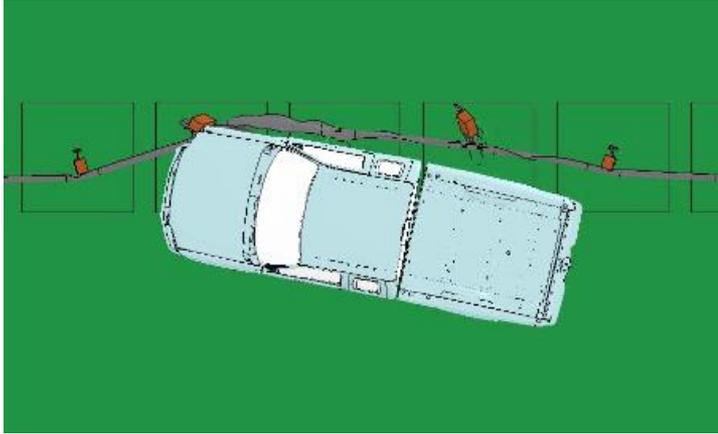
Thermal diffusivity of both lime and cement-stabilized subgrades were incorporated into a model that relates air and soil temperatures.

Software relates forecasted air temperatures to likely subgrade temperatures. May be used to inform case by case decisions as to whether cold weather exceptions can be made.

Suggests that CaCl_2 modification of soil-cement is not a mature enough approach to serve as a method for mitigating the effects of low temperatures on strength gain. Additional data needed.



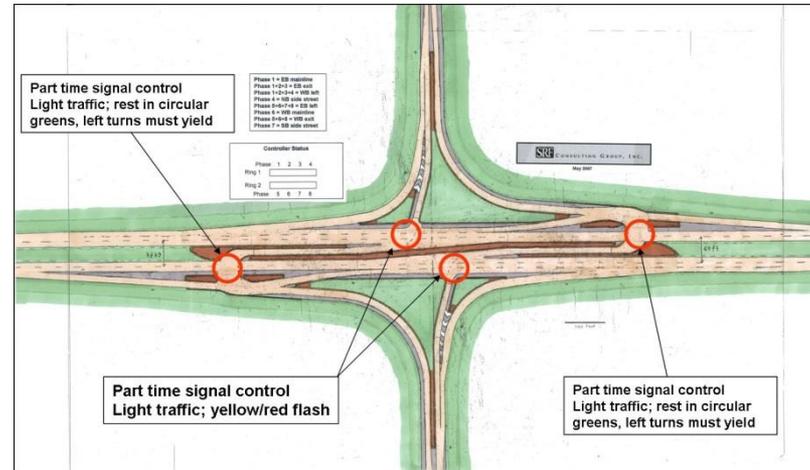
Safety: Finite Element Analysis of Guardrail Vehicle Impact



Are guardrail designs safe for different types of vehicles?



Superstreet Benefits and Capacities



Superstreet outperformed the conventional intersection at each location

Reduced overall average travel time per vehicle traveling through the intersection.

Un-signalized superstreets showed a significant reduction in total, angle and right turn, and left turn collisions in all analyses.

Analyses also showed a significant reduction in fatal and injury collisions as well.





NCDOT Research Supports Federal, State and Local Agencies



Getting Involved

Submit Research Needs Statements

- The Research and Development Unit is available to assist
- Forms are available on our [website](#)

Review Active AASHTO and FHWA Pooled Funds

- www.pooledfund.org
- Are there any with which think NCDOT should participate?

Submit NCHRP Ideas

- Projects that are large, national issues
- R&D can assist or connect you to the right people that can

Targeted research using Branch/Division/Unit funds and Master Agreements with Universities

- These agreements are low overhead
- Projects can be established quickly

Surveys: Need information on practices in other states?

- We can distribute survey requests to all 50 states + AASHTO





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Research Connect Page (for Forms and Other Info):

<https://connect.ncdot.gov/projects/planning/Pages/ResearchAnalysis.aspx>

Research Directory Page:

<https://apps.dot.state.nc.us/dot/directory/authenticated/UnitPage.aspx?id=8781>

